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CCL REPORT NO. 147

DESERT FIELD TEST - ALL WEATHER BRAKE FLUID

BY

CHARLES B. JORDAN

AMCMS CODE NO. 5025.11.802
DA PROJECT 1-H-0-24401-108

16 AUGUST 1963

ABERDEEN PROVING GROUND
MARYLAND

DESTROY; DO NOT RETURN

418590



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DESERT FIELD TEST - ALL WEATHER BRAKE FLUID

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Charles B. Jordan

16 August 1963

AMCMS Code No. 5025.11.802

Dept of the Army Project No.
I-H-O-24401-108

U. S. Army Coating and Chemical Laboratory
Aberdeen Proving Ground
Maryland

UNCLASSIFIED

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ABSTRACT

The object of this test was to evaluate the high temperature field performance of an all-weather hydraulic brake fluid. This report covers the results of desert tests at Yuma Test Station, Arizona.

New brake cylinders were packaged with the all-weather brake fluid and installed on $\frac{1}{4}$ ton, $\frac{3}{4}$ ton, $2\frac{1}{2}$ ton and 5 ton facility vehicles; all-weather fluid was placed in the brake systems; the vehicles were then placed in normal facility operation during the test period of 12 June 1962 to 25 February 1963.

The all-weather brake fluid performed satisfactorily in all vehicles throughout the test period.

I. INTRODUCTION

Aberdeen Proving Ground, Maryland, was requested by Research and Engineering Directorate, OTAC, ORDMC-RP.4, AUS-20 dated 29 November 1961, to conduct field tests on an all-weather brake fluid. This fluid had been developed by the Coating and Chemical Laboratory (CCL Report No. 115) and combined the essential high temperature requirements of Federal Specification VV-H-910a, Hydraulic Fluid, Non-Petroleum Base, Automotive and the low temperature requirements of Military Specification MIL-H-13910, Hydraulic Fluid, Non-Petroleum Base, Automotive Brake, Arctic.

Two phases of testing were outlined: (a) High temperature testing at Yuma Test Station, Arizona; (b) Arctic testing at Fort Wainwright, Alaska. This report covers results of the high temperature field tests at Yuma Test Station.

II. DETAILS OF TEST

A. Test Vehicles

Ten vehicles listed in Table I, Appendix B, were used in this test. These vehicles were facility vehicles in use at Yuma Test Station and consisted of 3 - $\frac{1}{4}$ ton, 2 - $\frac{3}{4}$ ton, 2 - $2\frac{1}{2}$ ton, and 3 - 5 ton vehicles.

B. Preparation of Vehicles for Test

All vehicles were prepared for test in accordance with Test Plan, Appendix A. One vehicle of each weight class was instrumented with thermocouples to measure brake fluid temperatures and air temperature in the vicinity of the cylinders. Thermocouples were installed at the master cylinder and on one wheel cylinder per axle.

C. Inspection of Vehicles During Test Period

Fluid level was checked periodically. A history of fluid additions, miles of operation, operating conditions, brake malfunctions and climatic conditions was recorded. This test was in operation from 12 June 1962 until 25 February 1963. At the completion of the test all brake cylinders were removed from the vehicles and forwarded to the laboratory for examination and evaluation.

III. RESULTS OF TEST

A. Inspection of Cylinders

Results of cylinder inspection are included in Table I, Appendix B. Test data supplied by field testing personnel included in Appendix C.

B. Fluid Additions

Fluid additions at the completion of the test were greater than anticipated. In many instances the presence of sand inside the cylinders caused leakage. Other causes of leakage not attributable to brake fluid

deficiency, included three faulty air-hydraulic cylinders, faulty threads on one cylinder assembly, one damaged washer seal, one loose line fitting at a master cylinder, and the presence of foreign materials inside four cylinders.

C. Gum Deposits and Corrosion

Cylinders returned to the laboratory from five of the vehicles had not been forwarded to the testing activity for this field test. These cylinders contained moderate to heavy amounts of gummy residue. Cylinders which had been forwarded for the test contained slight to moderate amounts of gummy residue. All cylinders were operational. No excessive corrosion was noted. Rubber cups showed slight scuffing, especially in cylinders containing sand.

D. Examination of Fluid

Results of tests run on fluid removed from cylinders are listed in Table 11, Appendix B. The decrease in boiling point is normal and attributed to condensed moisture. All samples of fluid contained some sediment; this sediment was analyzed and found to be high in silicon content. This indicated that sand and dust had accumulated in the cylinders. Some organic material was also found.

E. Temperature Data

Temperature data are listed in Appendix C. No extreme temperature readings were encountered. Ambient temperature recorded on test runs ranged from 76°F. to 113°F. Air temperature in the vicinity of the cylinders reached 151°F. The highest fluid temperature recorded during the test was 145°F. This is well below the boiling point of the brake fluid.

F. Malfunctions Caused by Brake Fluid Failure

No serious brake malfunctions attributable to the test fluid occurred during the test period.

IV. DISCUSSION

The all-weather brake fluid performed satisfactorily in this field test. Leakage was not directly attributable to the fluid, but to mechanical failures and the presence of foreign material in the brake system.

The gum deposits in the cylinders did not hinder brake operation during the test period. These deposits, however, could lead to future difficulties. A dimer acid inhibitor was included in the brake fluid formulation used in this test. It is believed that this dimer could have caused part of the gum deposits which were found. Tests are being conducted on a modification of the brake fluid formulation in which the dimer has been eliminated.

Several of the cylinders used in this test had not been packaged for the test. Available history on the cylinders indicated that they had been packaged with brake fluid almost a year before installation in the test vehicles. Brake fluids generally are not good packaging fluids; this would account for some of the gum deposits found in these cylinders at the end of the test.

The fact that the major portion of the test was conducted during the winter months and lack of temperature data during the final few months of the test minimized the value of the test. However, since no operational malfunctions occurred, it was concluded that the brake fluid would be satisfactory in desert operation.

V. RECOMMENDATION

Based on this field test and Arctic field tests which have been completed it is recommended that the all-weather fluid be adopted for military usage.

It is further recommended that formulations which do not include the dimer acid be laboratory and field evaluated.

VI. REFERENCES

1. Authority: Research and Engineering Directorate, OTAC, ORDMC-RP.4, AOS-20 dated 29 November 1961.
2. Federal Specification VV-H-910a Hydraulic Fluid, Non-Petroleum Base, Automotive.
3. Military Specification MIL-H-13910, Hydraulic Fluid, Non-Petroleum Base, Automotive Brake, Arctic.
4. CCL Report No. 115, Development of An All-Weather Hydraulic Brake Fluid, dated 9 February 1962.

APPENDICES

Appendix A - Test Plan

Appendix B - Tables

Appendix C - Field Reports

APPENDIX A

Test Plan

TEST PLAN

DESERT TESTING

1. Vehicles employed shall consist of the following facility vehicles at Yuma Test Activity, Yuma Test Station:

3 ea $\frac{1}{2}$ -ton M38A1
2 ea $\frac{3}{4}$ -ton M37
1 ea $2\frac{1}{2}$ -ton M108
1 ea $2\frac{1}{2}$ -ton M220
2 ea 5-ton M62
1 ea 5-ton M52

2. Brake fluid shall be removed from the system of each vehicle. Filtered compressed air shall be used to remove all existing fluid from lines. All brake cylinders (master and wheel) shall be removed and new cylinders installed. (New cylinders will be supplied by the Coating & Chemical Laboratory).

3. The brake system will be filled with the all-weather fluid, which will be supplied by the Coating & Chemical Laboratory. Brakes shall be adjusted for proper brake action.

4. A counter shall be installed for measuring brake applications.

5. Thermocouples shall be installed in positions to get brake fluid temperatures and air flow characteristics around the drums and brake wheel cylinders.

6. Vehicle shall be tagged stating that a brake test is in progress.

7. During the regular maintenance check-ups the fluid level in the master cylinder will be checked. Only test fluid will be added, and amounts recorded.

8. Memorandum reports shall be submitted to the Coating & Chemical Laboratory after 3 and 6 months. These reports shall include temperature data, miles of operation, number of brake applications, maintenance data, general road and terrain conditions and pertinent brake data.

9. After 6 months of service all brake fluid and brake cylinders shall be removed from the vehicles and forwarded to the Coating & Chemical Laboratory for inspection; evaluation, and analysis.

APPENDIX B

Tables

TABLE I

DESERT FIELD TESTS CYLINDER INSPECTION

	1	2	3
Vehicle	$\frac{1}{4}$ ton	$\frac{1}{4}$ ton	$\frac{1}{4}$ ton
Class	M38A1	M38A1	M38A1
Reg. No.	20977124	20975780	2A9096
<u>Condition of Cylinders</u>			
<u>Master Cylinder</u>	Operational	Operational	Operational
Cylinder Walls	OK	Slight deposits	Excessive sandy deposits
Piston	Slight deposits	OK	Excessive sandy deposits
Cups	OK	Slight scuffing	Slight scuffing
<u>Wheel Cylinders</u>	*Operational	Operational	Operational
Cylinder Walls	Slight to moderate deposits	Moderate deposits	Slight deposits
Pistons	Slight deposits (one gouged surface)	Moderate to heavy deposits (mod etching on one piston)	Slight etching
Cups	Slight deposit	Slight scuffing	Slight scuffing

REMARKS: * Thermocouple on right rear cylinder interferes with action of spring.

TABLE 1 - DESERT FIELD TESTS CYLINDER INSPECTION (CONTINUED)

	4	5	6	7
Vehicle	3/4 ton	3/4 ton	2½ ton	2½ ton
Class	M37	M37	M108	M220
Reg. No.	3B5757	2443415	4A1883	4A4212
<u>Condition of Cylinders</u>				
<u>Master Cylinder</u>	Operational	Operational	Operational	Operational
Cylinder Walls	Slight deposits	OK	OK	OK
Piston	Moderate sandy deposits	Slight deposits	Slight deposits	OK
Cups	Slight to moderate scuffing	Excessive scuffing	Slight scuffing	Slight to moderate scuffing
<u>Wheel Cylinders</u>	Operational	Operational	Operational	Operational
Cylinder Walls	Moderate to excessive sandy deposits	Moderate deposits	Moderate sandy deposits	Slight deposits
Piston	Moderate to excessive sandy deposits	Moderate deposits moderate etching	Moderate sandy deposits	Slight deposits
Cups	**Slight scuffing	Slight to moderate deposits slight scuffing	Slight to moderate deposits slight scuffing	Slight scuffing

REMARKS: ** Heavy indentations in cup face RF & RR.

TABLE 1 - DESERT FIELD TESTS CYLINDER INSPECTION (CONTINUED)

	8	9	10
Vehicle	5 ton	5 ton	5 ton
Class	M52	M62	M62
Reg. No.	5156241	54L35	00120342
<u>Condition of Cylinders</u>			
<u>Master Cylinder</u>	Operational	Operational	Operational
Cylinder Walls	Slight deposits	Slight deposits	Slight corrosion on front end
Piston	Slight deposits	Slight deposits	Moderate sandy deposits
Cups	Slight scuffing	Slight deposits slight scuffing	Slight scuffing
<u>Wheel Cylinders</u>	Operational	***Operational	Operational
Cylinder Walls	Slight to moderate deposits	Moderate to excessive sandy deposits	Excessive sandy deposits
Pistons	Moderate gritty deposits slight scoring	Moderate sandy deposits slight scoring	**** Moderate sandy deposits slight scoring
Cups	Moderate deposits slight scuffing	Moderate sandy deposits slight scuffing	Moderate sandy deposits slight scuffing

REMARKS: *** 5 cylinders in uniform condition, one cylinder (not forwarded for this test) in poor condition but operational.

**** RR Piston had a heavy scratch on surface.

TABLE 11

DESERT FIELD TESTS FLUID INSPECTION

Vehicle	Reg. No.	Boiling Point	Condition of Fluid
Original Fluid		318°F.	Light amber, clear
1	20977124	---	Slight precipitate
2	20975780	---	Slight precipitate
3	2A9096	---	Heavy sandy precipi- tate
4	3B5757	270°F	Moderate sandy precipitate
5	2443415	274°F	Moderate precipitate
6	4A1883	272°F	Moderate precipitate
7	4A4212	---	Slight precipitate
8	5156241	272°F	Slight sandy precipitate
9	54L35	274°F	Moderate sandy precipitate
10	00120342	272°F	Moderate sandy precipitate

TABLE 11
PHYSICAL AND CHEMICAL ANALYSIS

Location of Field	Depth (ft)	Temperature (°C)	Specific Gravity	pH	Conductivity (μmhos/cm)	Dissolved Solids (mg/l)	Total Solids (mg/l)	Calcium (mg/l)	Magnesium (mg/l)	Hardness (mg/l)	Chloride (mg/l)	Sulfate (mg/l)	Other Anions (mg/l)
Point A, Lake	10	15.2	1.001	7.2	150	150	150	100	50	150	100	50	0
Point B, Lake	15	14.8	1.001	7.1	140	140	140	90	50	140	100	40	0
Point C, Lake	20	14.5	1.001	7.0	130	130	130	80	50	130	100	30	0
Point D, Lake	25	14.2	1.001	6.9	120	120	120	70	50	120	100	20	0
Point E, Lake	30	14.0	1.001	6.8	110	110	110	60	50	110	100	10	0
Point F, Lake	35	13.8	1.001	6.7	100	100	100	50	50	100	100	0	0
Point G, Lake	40	13.5	1.001	6.6	90	90	90	40	50	90	100	0	0
Point H, Lake	45	13.2	1.001	6.5	80	80	80	30	50	80	100	0	0
Point I, Lake	50	13.0	1.001	6.4	70	70	70	20	50	70	100	0	0
Point J, Lake	55	12.8	1.001	6.3	60	60	60	10	50	60	100	0	0
Point K, Lake	60	12.5	1.001	6.2	50	50	50	0	50	50	100	0	0
Point L, Lake	65	12.2	1.001	6.1	40	40	40	0	50	40	100	0	0
Point M, Lake	70	12.0	1.001	6.0	30	30	30	0	50	30	100	0	0
Point N, Lake	75	11.8	1.001	5.9	20	20	20	0	50	20	100	0	0
Point O, Lake	80	11.5	1.001	5.8	10	10	10	0	50	10	100	0	0
Point P, Lake	85	11.2	1.001	5.7	5	5	5	0	50	5	100	0	0
Point Q, Lake	90	11.0	1.001	5.6	0	0	0	0	50	0	100	0	0
Point R, Lake	95	10.8	1.001	5.5	0	0	0	0	50	0	100	0	0
Point S, Lake	100	10.5	1.001	5.4	0	0	0	0	50	0	100	0	0

APPENDIX C

Field Reports

U. S. ARMY ORDNANCE TEST ACTIVITY
YUMA TEST STATION
YUMA, ARIZONA

W. O. No. 0168
RJSchick/bjg/2060

Refer to:

ORDEG-TA-ET-AU

TITLE: First Memorandum Report on Summer Test (1962) of All
Weather Brake Fluid, OMS 5010.11.80200.02

TO: Commanding General, Aberdeen Proving Ground, Maryland
ATTN: ORDEG-DPS-DF

Reporting Period: 15 May to 16 July 1962

Reference: DF, ORDEG-DPS-DF, dated 29 Aug 61, Incl. No. 1
DF, ORDEG-DPS-DF, dtd, 6 Jun 62, Incl. No. 2

INTRODUCTION

Wheel cylinders and master cylinders provided by Coating and Chemical Laboratory were installed on one 1/4 ton truck, one 3/4 ton truck, two 2 1/2 ton trucks, and one 5 ton truck.

The brake system of each vehicle was filled with test brake fluid.

One vehicle of each weight class was instrumented with thermocouples to measure brake fluid temperature, brake cylinder skin temperature, and air temperature in the vicinity of the cylinder. The thermocouples were installed at the master cylinder and one wheel cylinder per axle.

Counters were installed on the above vehicles, and two other vehicles which will be equipped with test brakes, to measure the number of brake applications.

The vehicles were returned to normal facility service when the installations were completed.

Brake cylinders are being installed on 5 remaining facility vehicles.

RESULTS

The following table presents the mileages accumulated and the number of brake applications recorded.

The information contained in this report is tentative and should be so treated.

ORDEG-TA-ET-AU

TITLE: First Memorandum Report on Summer Test (1962) of All Weather
Brake Fluid, OMS 5010.11.80200.02

TABLE I

<u>Vehicle</u>	<u>USA Reg. No.</u>	<u>Miles</u>	<u>Number of Brake Applications</u>
Truck, Utility, 1/4 Ton, 4x4, M38A1	20977124	419	2181
Truck, Cargo, 3/4 Ton, 4x4, M37	2443415	14	42
Truck, Van, 2 1/2 Ton, 6x6, M220	4A4212	12	35
Truck, Wrecker, 2 1/2 Ton, 6x6, M108	4A1883	248	624
Truck, Tractor, 5 Ton, 6x6, M52	5156241	147	493

Temperature data taken on Truck, Utility, 1/4 Ton, 4x4, M38A1, USA Reg. No. 20977124 are included as Inclosure 1 and Inclosure 2.

Maintenance was performed on the brake system of Truck, Wrecker, 2 1/2 Ton, 6x6, M108 after 192 miles of operation. There was a leak in the air pack due to a defective gasket. The gasket (FSN 2530-753-9337) was replaced.

The mileage on the vehicles was accumulated on paved and secondary roads. The majority of the operation was on level terrain with occasional trips on hilly terrain.

FUTURE WORK

The remaining test master cylinders and wheel cylinders will be installed in two Trucks, Utility, 1/4 Ton, 4x4, M38A1, one Truck, Cargo, 3/4 Ton, 4x4, M37, and two Truck, Tractor, 5 Ton, 6x6, M62, and counters will be installed in the remaining one Truck, Cargo, 3/4 Ton, 4x4, M37 and one Truck, Tractor, 5 Ton, 6x6, M62.

Brake application counters will be installed in one each M37 and M62. Temperature data and brake application data will be taken.

SUBMITTED:

Robert J. Schick

ROBERT J. SCHICK
Project Engineer

APPROVED:

WILLIAM L. SNIDER
Chief, Automotive Branch

The information contained in this report is tentative and should be so treated.

2 Incl

1-2 Temperature data

TEST DATA

U.S. ARMY ORDNANCE TEST ACTIVITY
AUTOMATIC PRINTER
PROJECT NO. 0168 PROJECT ENGR. R. Schick
VOLUME USA 2097024 H/H 1/4 Ton
TEST STATION

DATE (June)

TIME

AMBIENT TEMPERATURE

ODDSENER READING

CONTRACT READING

RUNNING TIME BEFORE READING(Minutes)

TERRAIN

TEMPERATURES OF

1. Fluid Temp., Master Cyl.
2. Cyl. Skin Temp., Master Cyl.
3. Air Temp. in Vicinity, Master Cyl.
4. Fluid Temp., Front Wheel Cyl.
5. Cyl. Skin Temp., Front Wheel Cyl.
6. Air Temp. in Vicinity, Front Wheel Cyl.
7. Fluid Temp., Int. Wheel Cyl.
8. Cyl. Skin Temp., Int. Wheel Cyl.
9. Air Temp. in Vicinity, Int. Wheel Cyl.
10. Fluid Temp., Rear Wheel Cyl.
11. Cyl. Skin Temp., Rear Wheel Cyl.
12. Air in Vicinity, Rear Wheel Cyl.

(5)

TEST DATA

U.S. ARMY ORDNANCE TEST ACTIVITY		PROJECT NO. 0168		PROJECT ENGINEER R. Schick	
TEST STATION NO. 5156241		TEST STATION NO. 5156241		TEST STATION NO. 5-Ton	
DATE (June)		18			
TIME		1520			
AMBIENT TEMPERATURE		102			
ODOMETER READING		22599			
COUNTING READING		---			
RUNNING TIME BEFORE READING (Minutes)		15			
TERRAIN		Level			
		Paved			
TEMPERATURES OF					
1. Fluid Temp. Master Cyl.		129			
2. Cyl. Skin Temp., Master Cyl.		129			
3. Air Temp. in Vicinity, Master Cyl.		129			
4. Fluid Temp., Front Wheel Cyl.		102			
5. Cyl. Skin Temp., Front Wheel Cyl.		102			
6. Air Temp. in Vicinity, Front Wheel Cyl.		102			
7. Fluid Temp., Int. Wheel Cyl.		102			
8. Cyl. Skin Temp., Int. Wheel Cyl.		105			
9. Air Temp. in Vicinity, Int. Wheel Cyl.		105			
10. Fluid Temp., Rear Wheel Cyl.		105			
11. Cyl. Skin Temp., Rear Wheel Cyl.		106			
12. Air in Vicinity, Rear Wheel Cyl.		104			

HEADQUARTERS YUMA TEST STATION
YUMA, ARIZONA

W. O. No. 0160
RJSchick/pjh/2339

Refer to:

STEYT-TOE

TITLE: Second Memorandum Report on Summer Test (1962) of All
Weather Brake Fluid, OMS 5010.11.80200.02

TO: Commanding Officer, Aberdeen Proving Ground, Maryland
ATTN: STEAP-DG-DF

Reporting Period: 17 July 1962 to 1 October 1962

INTRODUCTION

Test brake fluid, and brake application counters were installed on the remaining five facility vehicles: two 1/4-ton trucks, one 3/4-ton truck, and two 5-ton trucks. These vehicles were returned to facility service, and temperature data and brake application data were taken.

RESULTS

The following table presents the mileages accumulated and the number of brake applications recorded to date.

Table I.

Vehicle	USA Reg. No.	Miles	No. of Brake Applications
Truck, Utility, 1/4-ton, 4x4, M38A1	20977124	1403	5857
Truck, Utility, 1/4-ton, 4x4, M38A1	20975780	622	4792
Truck, Utility, 1/4-ton, 4x4, M38A1	2A9096	715	2536
Truck, Cargo, 3/4-ton, 4x4, M37	3B5757	620	2184
Truck, Cargo, 3/4-ton, 4x4, M37	2443415	824	2822
Truck, Wrecker, 2-1/2 ton, 6x6, M108	4A1883	1641	3553
Truck, Van, 2-1/2 ton, 6x6, M220	4A4212	1136	1390
Truck, Tractor, 5-ton, 6x6, M52	5156241	1243	2915
Truck, Wrecker, 5-ton, 6x6, M62	54L35	209	1582
Truck, Wrecker, 5-ton, 6x6, M62	00120342	655	977

Temperature data were taken on M52 truck, USA Reg No. 5156241, M37 truck, USA Reg No. 2443415, and M38A1 truck, USA Reg No. 20977124, and are presented in Inclosure 1, 2, and 3, respectively.

The information contained in this report is tentative and should be so treated.

STEYT-TOE

TITLE: Second Memorandum Report on Summer Test (1962) of All Weather
Brake Fluid, OMS 5010.11.80200.02/0163

The milcage on the vehicles was accumulated on paved and secondary roads. The majority of the operation was on level terrain with occasional trips on hilly terrain.

One brake malfunction occurred during this period (Incl 4).

FUTURE WORK

Future work will include the collection of temperature data and brake application data. The brake parts will be removed at the end of the test, and returned to Coating and Chemical Laboratory.

SUBMITTED:

Robert J. Schick

ROBERT J. SCHICK
Project Engineer

APPROVED:

William L. Snider

WILLIAM L. SNIDER
Chief, Automotive Branch

The information contained in this report is tentative and should be so treated.

DEFECT RECORD

DATE: 31 July 1962

DEFECT NO.: 4 ENGINEER: R. Schick
 ITEM UNDER TEST: All Weather Brake Fluid
 VEHICLE TYPE: M220 REG NO: USA 4A4212
 DATE OF INCIDENT: 30 Jul 62 ODOMETER: 9316.7 PART MILEAGE:
 DEFICIENCY ☒ SHORTCOMING ☐ IMPROVEMENTS ☐ DESIGN ☐ MANUFACTURING ☐

SNL GROUP NOMENCLATURE PART NO.

12 Cylinder, Air-Hydraulic, Assembly 7376689

SYNOPSIS:

The brakes were inoperative due to lack of fluid.

CAUSE:

A faulty thread on the plate, ORD No. BX375911 allowed aluminum filings into the fluid chambers. These filings disrupted sealing action allowing brake fluid into the air side of the air-hydraulic cylinder assembly.

ACTION:

The air-hydraulic cylinder assembly was replaced.

TEST DATA

Automotive Branch		Project No.	Project Engr.		R. Schick	
U. S. ARMY ORDNANCE TEST ACTIVITY		Vehicle	USA Reg No.		51562413	
Yuma Test Station, Yuma, Arizona		All temp. in F, all press. in psi unless otherwise noted				
5-Ton						
Date, September	27	27	27	27	27	27
Time	0900	0915	0925	0935	0945	1000
Ambient temperature	80.6	81.2	81.5	81.9	82.8	82.8
Odometer reading	23804	23809	23814	23819	23824	23829
Running time bef reading (min)	0	15	25	35	45	60
Terrain	←	Level	---	Paved	→	
Temperatures of						
1. Fluid temp, master cyl	81	95	106	115	115	120
2. Cyl skin temp, master cyl	81	95	102	115	119	120
3. Air temp in vicinity, master cyl	89	115	114	116	116	130
4. Fluid temp, front wheel cyl	80	85	82	85	92	104
5. Cyl skin temp, front wheel cyl	80	85	85	84	100	110
6. Air temp in vicinity, front wheel cyl	84	84	80	85	96	104
7. Fluid temp, int wheel cyl	84	84	80	85	96	104
8. Cyl skin temp, int wheel cyl	82	84	85	85	96	104
9. Air temp in vicinity, int wheel cyl	82	84	85	85	99	105
10. Fluid temp, rear wheel cyl	83	90	87	94	104	111
11. Cyl skin temp, rear wheel cyl	82	90	95	103	104	130
12. Air in vicinity, rear wheel cyl	82	90	90	96	104	130

TEST DATA

U.S. ARMY ORDNANCE TEST ACTIVITY		AUTOMOTIVE BRANCH		PROJECT NO. 0168		PROJECT ENGR. R. Schick	
TANK TEST STATION, GULF, ARIZONA		VEHICLE, USA Reg No. 2443415		DATE			
		ALL TEMP IN °C, ALL PRESS. IN PSI UNLESS OTHERWISE NOTED					
3/4-ton							
Date		23	22	22	22		
Time		1345	1420	0955	1010		
Ambient temperature		109	109	90	90		
Odometer reading		6836	6842	7127	7130		
Running time bef reading (min)		15	25	0	15		
Terrain		← July →		← August →			
		Gravel ← Level →		Paved →			
Temperatures of							
1. Fluid temp master cyl		86	95	104	110	115	
2. Cyl skin temp, master cyl		86	95	104	110	115	
3. Air temp in vicinity, master cyl		86	95	104	110	115	
4. Fluid temp, front wheel cyl		90	103	104	109	115	
5. Cyl skin temp, front wheel cyl		88	100	103	109	116	
6. Air temp in vicinity, front wheel cyl		75	84	110	135	138	
7. Fluid temp, int wheel cyl							
8. Cyl skin temp, int wheel cyl							
9. Air temp in vicinity, int wheel cyl							
10. Fluid temp, rear wheel cyl		75	82	109	115	123	
11. Cyl skin temp, rear wheel cyl		92	100	106	115	123	
12. Air in vicinity, rear wheel cyl		86	94	110	135	140	

U.S. ARMY ORDNANCE TEST ACTIVITY

PROJECT No. 0168 PROJECT ENGR. B. Shick
 VEHICLE USA Reg No. 20977124 DATE _____
 ALL TEMP. IN °F. ALL PRESS. IN PSI UNLESS OTHERWISE NOTED

ALL TEMP. IN °F, ALL PRESS. IN PSI UNLESS OTHERWISE NOTED

1/4-Ton

~~← July → ← August →~~

Date	19	19	21	21	21
Time	1040	1125	1415	1440	1505
Ambient temperature	92	99	110	113	113
Odometer reading	1556	1561	1837	1892	1895
Running time bef reading (min)	15	15	10	20	10
Terrain	←Level	←Level	←	Gravel	Level
Temperatures of					
1. Fluid temp, master cyl	116	125	130	144	145
2. Cyl skin temp, master cyl	116	125	130	144	145
3. Air temp in vicinity, master cyl	113	115	126	138	145
4. Fluid temp, front wheel cyl	109	103	114	124	124
5. Cyl skin temp, front wheel cyl	109	103	114	124	124
6. Air temp in vicinity, front wheel cyl	116	105	119	125	124
7. Fluid temp, int wheel cyl					
8. Cyl skin temp, int wheel cyl					
9. Air temp in vicinity, int wheel cyl					
10. Fluid temp, rear wheel cyl	106	108	115	120	123
11. Cyl skin temp, rear wheel cyl	106	108	115	120	123
12. Air in vicinity, rear wheel cyl	109	108	115	120	123

ORDERED FOR THE UNITED STATES OF AMERICA

SHEET OF SHEETS

HEADQUARTERS YUMA TEST STATION
YUMA, ARIZONA

W. O. No.: 7200
KMB/hi/pjh/2060

Refer to:

STEYT-TOE

TITLE: Third Memorandum Report on Summer Test (1962) of All Weather Brake Fluid, AECIS 5010.11.80200.02

TO: Commanding Officer, Aberdeen Proving Ground, Aberdeen, Maryland,
ATTN: STEAP-DS-DF

Reporting Period: 2 October 1962 to 17 December 1962

INTRODUCTION

Tests have been completed on the M38A1 truck, USA Reg. No. 20977124, M52 truck, USA Reg. No. 5156241, and M108 truck, USA Reg. No. 4A1883. The brake parts from these vehicles will be removed and returned to Coating and Chemical Laboratory.

RESULTS

The following table presents the mileages accumulated and the number of brake applications recorded to date.

Table I. Mileage and Brake Applications

<u>Vehicle</u>	<u>USA Reg. No.</u>	<u>Miles</u>	<u>No. of Brake Applications</u>
Truck, Utility, 1/4-ton, 4x4, M38A1	20977124	2718	9500
Truck, Utility, 1/4-ton, 4x4, M38A1	20975780	1748	9315
Truck, Utility, 1/4-ton, 4x4, M38A1	219096	1265	5735
Truck, Cargo, 3/4-ton, 4x4, M37	3E5757	2605	7930
Truck, Cargo, 3/4-ton, 4x4, M37	2443415	1656	5266
Truck, Wrecker, 2-1/2 ton, 6x6, M108	4A1883	2402	4924
Truck, Van, 2-1/2 ton, 6x6, M220	4A4212	2794	2974
Truck, Tractor, 5-ton, 6x6, M52	5156241	1770	3537
Truck, Wrecker, 5-ton, 6x6, M52	54L35	1273	4838
Truck, Wrecker, 5-ton, 6x6, M52	00120342	1056	1762

Temperature data were taken on M108 truck, USA Reg. No. 4A1883, M52 truck, USA Reg. No. 5156241, and M37 truck, USA Reg. No. 2443415, and are presented in Inclosures 1, 2, 3, and 4, respectively.

The information contained in this report is tentative and should be so treated.

STEYT-TOE

TITLE: Third Memorandum Report on Summer Test (1962) of All Weather Brake Fluid, AKME 5010.11.80200.02/7200

The mileage on the vehicles was accumulated on paved and secondary roads. The majority of the operation was on level terrain with occasional trips on hilly terrain.

Two brake malfunctions occurred during this period (Incl 5 and 6).

FUTURE WORK

Future work will include the collection of brake application data for the remaining vehicles. These brake parts will be removed at the end of the test, and returned to Coating and Chemical Laboratory.

SUBMITTED:

APPROVED:

KENNETH H. BOHI
Test Director

IAN C. FORREST
Acting Chief, Mobility Branch

The information contained in this report is tentative and should be so treated.

DEFECT RECORD

DATE: 29 Oct 62
 DEFECT NO.: 5 ENGINEER: Bohi
 ITEM UNDER TEST: All Weather Brake Fluid
 VEHICLE TYPE: M108 REG NO.: USA 4/1883
 DATE OF INCIDENT: 24 Sep 62 ODOMETER: 19048 PART MILEAGE: 1636
 DEFICIENCY ☐ SHORTCOMING ☒ IMPROVEMENTS ☐ DESIGN ☐ MANUFACTURING ☐

SNL GROUP	NOMENCLATURE	PART NO.
-----------	--------------	----------

12

7539314

SYNOPSIS OF DEFECT:

The brakes were inoperative due to lack of fluid.

CAUSE:

Rubber seal (7539314) was torn allowing brake fluid into the air side of the air-hydraulic cylinder assembly. Since the rubber seal showed no signs of chemical deterioration, the cause was probably fatigue.

ACTION TAKEN:

The air-hydraulic cylinder was replaced.

DEFECT RECORD

DATE: 14 Dec 62

DEFECT NO.: 6 ENGINEER: Bohl

ITEM UNDER TEST: All Weather Brake Fluid

VEHICLE TYPE: M37 REG NO.: USA 2443415

DATE OF INCIDENT: 7 Dec 62 ODOMETER: 8421 PART NO.: 1664

DEFICIENCY ☐ SHORTCOMING ☒ IMPROVEMENTS ☐ DESIGN ☐ MAINTENANCE ☐

SNL GROUP _____ NO. OF DEFECTS _____ PART NO. _____

SYNOPSIS OF DEFECT:

Brake application was soft and spongy.

CAUSE:

Washer seal right front wheel was defective.

ACTION TAKEN:

The washer seal was replaced.

TEST DATA

DIRECTORATE OF GROUND TESTING		Project No. 7202	Project Engr. Bohl
Yuma Test Station, Yuma, Arizona		Vehicle 42833, 2-1/2 ton	Date
All temp in °F, all press in psi unless otherwise noted			
Date	October		
Time		4	4
Ambient temperature		1400 1435	1445 1455
Odometer reading		93	
Running time before reading (min.)		19114 19119	19124 19129
Terrain		0 5	15 25
TEMPERATURES °F			
1. Fluid temp master cyl		91	90 94
2. Cyl skin temp master cyl		91	90 95 94
3. Air temp in vicinity, master cyl		91	95 93 94
4. Fluid temp, front wheel cyl		91	94 97 109
5. Cyl skin temp, ft wheel cyl		91	95 87 91
6. Air temp in vicinity, ft wheel cyl		91	104 94 104
7. Fluid temp, int wheel cyl			
8. Cyl skin temp, int wheel cyl			
9. Air temp in vicinity, int wheel cyl			
10. Fluid temp, rear wheel cyl		107	104 95 104
11. Cyl skin temp, rear wheel cyl		107	100 91 100
12. Air in vicinity, rear wheel cyl		107	95 84 82

TEST DATA

DIRECTORATE OF GROUND TESTING			Project No. 7200		Project Engr Eohl	
Yuma Test Station, Yuma, Arizona			Vehicle 4A1883, 2-1/2 ton		Date	
All temp in °F, all press in psi unless otherwise noted						
Date	October		25	25	25	25
Time			0915	0930	1000	1030
Ambient temperature			72	74	75	75
Gonimeter reading			19411	19421	19426	19431
Counter reading			4390	4395	4402	4405
Running time before reading (min.)			0	15	35	45
Terrain			Level			
			Faved			
TEMPERATURE °F						
1. Fluid temp master cyl			87	95	100	112
2. Cyl skin temp, master cyl			89	97	105	115
3. Air temp in vicinity, master cyl			83	95	101	110
4. Fluid temp, ft wheel cyl			85	85	85	95
5. Cyl skin temp, ft wheel cyl			94	94	95	104
6. Air temp in vicinity, ft wheel cyl			86	85	87	95
7. Fluid temp, int wheel cyl						
8. Cyl skin temp, int wheel cyl						
9. Air temp in vicinity, int wheel cyl						
10. Fluid temp, rear wheel cyl						
11. Cyl skin temp, rear wheel cyl						
12. Air in vicinity, rear wheel cyl						

TEST DATA

DIRECTORATE OF GROUND TESTING		Project No. 7200		Project Engr Eohl	
Yuma Test Station, Yuma, Arizona		Vehicle UCA 5150241, 5-ton, .Date		All temp in °F, all press in psi unless otherwise noted	
Date	October	2	2	2	2
Time		1330	1345	1355	1405
Ambient temperature		1330	1345	1355	1405
Odometer reading		23854	23950	24000	24050
Running time before reading (min)		0	15	15	15
Terrain		Lot	→	Level	→
TEMPERATURES °F					
1. Fluid temp. master cyl		105	122	130	135
2. Cyl skin temp. master cyl		105	119	125	132
3. Air temp in vicinity, master cyl		105	134	125	144
4. Fluid temp. ft wheel cyl		102	102	109	109
5. Cyl skin temp. ft wheel cyl		105	109	112	114
6. Air temp, in vicinity, ft wheel cyl		103	102	109	109
7. Fluid temp, int wheel cyl		103	102	109	109
8. Cyl skin temp, int wheel cyl		103	109	109	109
9. Air temp in vicinity int wheel cyl		103	102	102	102
10. Fluid temp, rear wheel cyl		105	102	110	115
11. Cyl skin temp, rear wheel cyl		105	113	120	128
12. Air in vicinity, rear wheel cyl		105	111	114	120
5th gear hd		H	H	H	H

DIRECTORATE OF GROUND TESTING

Yuma Test Station, Yuma, Arizona

Project No. 7200 Project Engr. Boul
Vehicle USA 2443415 3/-ton Date _____
All temp in °F, all press in psi unless otherwise

[illegible]

(30)

HEADQUARTERS, YUMA TEST STATION
YUMA, ARIZONA

Project No.: 593-21-061
KHBoh1/kam/2060

Refer to:

STEYT-TOE

TITLE: Fourth and Final Memorandum Report on Summer Test (1962)
of All Weather Brake Fluid

TO: Commanding Officer, Aberdeen Proving Ground, Aberdeen,
Maryland, ATTN: STEAP-DS-DF

Reporting Period: 18 December 1962 through 25 February 1963

INTRODUCTION

Test operations have been completed with the brake fluid and brake components on all the vehicles. All the parts have been removed and turned in to supply for shipment to the Coating and Chemical Laboratory.

RESULTS

The following table presents the final mileages accumulated and the number of brake applications recorded.

Table 1. Mileage and Brake Applications

<u>Vehicle</u>	<u>USA Reg. No.</u>	<u>Miles</u>	<u>No. of Brake Applications</u>
Truck, utility, 1/4-ton, 4x4, M38A1	20977124	2718	9500
Truck, utility, 1/4-ton, 4x4, M38A1	20975780	2314	12788
Truck, utility, 1/4-ton, 4x4, M38A1	2A9096	1458	7401
Truck, cargo, 3/4-ton, 4x4, M37	3B5757	2787	9288
Truck, cargo, 3/4-ton, 4x4, M37	2443415	2131	7028
Truck, wrecker, 2-1/2 ton, 6x6, M108	4A1883	2402	4924
Truck, van, 2-1/2-ton, 6x6, M220	4A4212	3064	3379
Truck, tractor, 5-ton, 6x6, M52	5156241	1770	3537
Truck, wrecker, 5-ton, 6x6, M62	54L35	1896	6800
Truck, wrecker, 5-ton, 6x6, M62	00120342	1130	2089

All of the vehicles are facility type vehicles that receive normal usage on paved and secondary roads.

The information contained in this report is tentative and should be so treated.

STEYT-TOE

TITLE: Fourth and Final Memorandum Report on Summer Test (1962)
of All Weather Brake Fluid, Project No. 593-21-061

Maintenance performed on the brake systems during the complete test was as follows:

28 May 1962, USA Reg No. 4A1883, mileage 0

Received master cylinder with damaged plunger seal. The seal was replaced and the master cylinder installed in the vehicle.

28 May 1962, USA Reg No. 5156241, mileage 0

Received master cylinder with bracket broken off. Replaced master cylinder with another one.

3 July 1962, USA Reg No. 4A1883, mileage 169

Brake application was soft and spongy. Removed and inspected hydropack and found leak in air hydraulic brakes. Replaced gasket (FSN-2530-753-9337), inlet and exhaust valve cage and cap.

30 July 1962, USA Reg No. 4A4212, mileage 380

The brakes were inoperative because of a lack of fluid. A faulty thread on the plate (ORD No. BX375911) allowed aluminum filings into the fluid chambers. These filings disrupted the action allowing brake fluid into the air side of the air hydraulic cylinder assembly. The air hydraulic cylinder assembly was replaced.

24 August 1962, USA Reg No. 5156241, mileage 763

Brakes were reported soft and spongy. Found brake fluid level low and added 600 ml of brake fluid to master cylinder. Bled master cylinder and air pack unit and checked wheel cylinder adjustment.

24 September 1962, USA Reg No. 4A1883, mileage 1649

Added 377 ml of brake fluid to master cylinder to bring the brake fluid to correct level. Removed old air pack and installed new pack (FSN-2530-040-2188). Returned vehicle to service.

STEYT-TOE

TITLE: Fourth and Final Memorandum Report on Summer Test (1962)
of All Weather Brake Fluid, Project No. 593-21-061

23 October 1962, USA Reg No. 3B5757, mileage 951

Filled master cylinder with 400 ml of brake fluid. Bled lines and check wheel adjustments. Tightened fitting on line in front of the master cylinder.

12 December 1962, USA Reg No. 2443415, mileage 1664

Brakes were reported spongy. Replaced a washer seal on right front wheel. Added 200 ml of brake fluid to the master cylinder.

14 December 1962, USA Reg No. 5156241, mileage 1770

Added 400 ml of brake fluid to master cylinder. When removing test components at the conclusion of test, the right front cylinder, right intermediate cylinder, and the left rear cylinder were all found to be leaking with foreign material visible in the cylinders.

17 December 1962, USA Reg No. 20977124, mileage 2723

When removing test parts at end of test, the right rear cylinder was found to be leaking past the cup with foreign material visible in the cylinder.

8 January 1963, USA Reg No. 00120342, mileage 1059

Brakes were reported to be soft and spongy. Added 250 ml of brake fluid to the master cylinder and bled the lines.

7 January 1963, USA Reg No. 54L35, mileage 1272

Brakes not operating correctly. Added 450 ml of brake fluid to the brake cylinder but found no leaks or troubles in the cylinders or the lines.

18 January 1963, USA Reg No. 4A4212, mileage 3064

Test brake fluid was removed from brake system by mistake and standard fluid added. The test cylinders were removed and cleaned with compressed air and will be shipped to the Coating and Chemical Laboratory dry.

30 January 1963, USA Reg No. 2A9096, mileage 1458

Added 450 ml of brake fluid to the master cylinder before removing the vehicle from the test. Found no leaks or trouble.

STEYT-TOE

TITLE: Fourth and Final Memorandum Report on Summer Test (1962)
of All Weather Brake Fluid, Project No. 593-21-061

1 February 1963, USA Reg No. 2443415, mileage 2131

Added 40 ml of test brake fluid to the master cylinder. Found both cups of right rear cylinder and right front cylinder leaking slightly.

7 February 1963, USA Reg No. 3B5757, mileage 2787

Added 280 ml of brake fluid to the master cylinder before removing test parts. Also found the four wheel cylinders to be leaking.

12 February 1963, USA Reg No. 20975780, mileage 2314

Added 80 ml of test brake fluid to the master cylinder before removing test brakes. Also found the left rear and right front wheel cylinders leaking slightly and the left front cylinder leaking heavily.

15 February 1963, USA Reg No. 00120342, mileage 1130

Added 270 ml of test brake fluid to the master cylinder before removing test brakes. Also found the right intermediate and the right rear cylinder leaking slightly with some foreign material visible in the cylinders.

25 February 1963, USA Reg No. 54L35, mileage 1896

Added 280 ml of test brake fluid to the master cylinder to bring to correct level. Also found left front cylinder cups leaking before the test cylinders were removed from the vehicle.

No brake malfunction occurred during this period.

SUBMITTED:

APPROVED:

Kenneth H. Bohl
KENNETH H. BOHL
Project Engineer

Ian C. Forrest
IAN C. FORREST
Acting Chief, Mobility Branch

The information contained in this report is tentative and should be so treated.

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The object of this test was to evaluate the high temperature field per- formance of an all weather hydraulic brake fluid. This report covers the results of desert tests at Yuma Test Station, Arizona. New brake cylinders were packaged with the all weather brake fluid and instal- led on $\frac{1}{4}$ ton, $\frac{3}{4}$ ton, $2\frac{1}{2}$ ton and 5 ton	The object of this test was to evaluate the high temperature field per- formance of an all weather hydraulic brake fluid. This report covers the results of desert tests at Yuma Test Station, Arizona. New brake cylinders were packaged with the all weather brake fluid and instal- led on $\frac{1}{4}$ ton, $\frac{3}{4}$ ton, $2\frac{1}{2}$ ton and 5 ton		
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<p>Unclassified</p> <p>facility vehicles; all weather fluid was placed in the brake systems; the vehicles were then placed in normal facility operation during the test period of 12 June 1962 to 25 February 1963.</p> <p>The all weather brake fluid performed satisfactorily in all vehicles throughout the test period.</p>	<p>Unclassified</p> <p>facility vehicles; all weather fluid was placed in the brake systems; the vehicles were then placed in normal facility operation during the test period of 12 June 1962 to 25 February 1963.</p> <p>The all weather brake fluid performed satisfactorily in all vehicles throughout the test period.</p>
<p>Unclassified</p> <p>facility vehicles; all weather fluid was placed in the brake systems; the vehicles were then placed in normal facility operation during the test period of 12 June 1962 to 25 February 1963.</p> <p>The all weather brake fluid performed satisfactorily in all vehicles throughout the test period.</p>	<p>Unclassified</p> <p>facility vehicles; all weather fluid was placed in the brake systems; the vehicles were then placed in normal facility operation during the test period of 12 June 1962 to 25 February 1963.</p> <p>The all weather brake fluid performed satisfactorily in all vehicles throughout the test period.</p>

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